# Interagency Crab Research Meeting
# December 11–13, 2002

by
Peter van Tamelen and
Doug Woodby

REGIONAL INFORMATION REPORT[1] NO. 5J03-08

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 25526
Juneau, Alaska 99802-5526

June 2003

[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data, this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

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The Hotel Captain Cook
Anchorage, AK

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**AGENDA**

RESEARCH REVIEW
WEDNESDAY, DECEMBER 11 (Endeavor Room)

Afternoon Session: 1:00–5:00 PM

I. Introductions

II. Opening remarks: Rich Marasco and Doug Woodby

III. Meeting agenda: Modify and Adopt

IV. Highlights of ongoing and planned crab research (15 minute maximum except as noted)

A. NMFS

1. RACE Kodiak 2002 activities—Bob Otto
2. Crab disease research—Frank Morado (30 minutes)
3. Chiniak Bay crab work—Brad Stevens (30 minutes)
4. Survival and growth of red king crab juveniles reared at different temperatures—Kathy Swiney

Coffee: 3:00–3:30 PM

5. The use of live microalgae in the culture of laboratory-raised Tanner and snow crab larvae—Sara Persselin
6. Research needs for crab stock assessment modeling—Jack Turnock (30 minutes)
7. Reproductive dynamics and life-history of Bering Sea snow crab—Lou Rugolo and Kirsten Gravel (30 minutes)

B. USGS

1. Crab distribution in Glacier Bay—Jim Taggart

THURSDAY, DECEMBER 12 (Aft Deck)

Coffee: 8:00–8:30 AM
Morning Session: 8:30 AM– 12:00 noon

C. Universities

1. Introduction and update on Gulf of Alaska seamount crabs and snow crab energetics—Tom Shirley, UAF, Juneau
2. Temperature effects on reproductive hormones in *Chionoectes opilio*—Jaqueline Mitchell, UAF, Juneau
3. The effect of temperature on embryonic development and larval characteristics in *Chionoecetes opilio*—Joel Webb, UAF, Juneau
4. Lipofuscin aging of snow crab—Bodil Bluhm and Tom Shirley, UAF, Juneau
5. Hormones and molting in *Chionoecetes opilio*—Sherry Tamone, UAS, Juneau
6. Female ontogenetic migration in relation to near-bottom temperature gradients—Billy Ernst, UW

Coffee: 10:00–10:30 AM

7. Tagging Tanner crabs using conventional and sonic tags to understand movement patterns—Julie Nielsen, UAF and USGS
8. Interannual variation of Dungeness crab larvae in southeastern Alaska—Won Park, UAF, Juneau
9. Movement and habitat utilization of golden king crabs in southeast Alaska—Zac Hoyt, UAF, Juneau

D. ADF&G

1. King and Tanner crab research overview—Jie Zheng, Headquarters
2. Southeast king and Tanner stock assessment—John Clark, Southeast
3. Southeast Dungeness stock assessment and management—Jan Rumble, Southeast

Lunch: 12:00–1:30 PM
Afternoon Session: 1:30–5:00 PM

4. History and recent management activity of the Petrel Bank red king crab—Karla Granath, Westward
5. New management strategies in Chignik, Kodiak, and the South Penisula—Mike Ruccio, Westward
6. Bering Sea and Aleutian Island pot survey update—Leslie Watson, Westward

7. Bristol Bay red king crab injury and tagging update—Skip Gish, Westward
8. Size at maturity in crabs—Dan Urban, Westward
9. King crab manual update—Susie Byersdorfer, Westward

Coffee: 3:00–3:30 PM

4. Personal use Tanner crab in Cook Inlet—Nicky Szarzi, Central
5. Central Region (CF)—Bill Bechtol, Central
6. Nome triennial survey—Betsy Brennan, Nome
7. Update of molecular genetics study of red king crab—Stew Grant, Anchorage

E. Revised Research Plan: Doug Woodby

F. Next Year's Meeting and Special Topic Suggestions

Crabby Hour and Dinner at the Snow Goose: 6:00–10:00 PM

OVERFISHING AND BIOLOGICAL REFERENCE POINTS
FRIDAY, DECEMBER 13 (Endeavor Room)

Coffee: 8:00–8:30 AM
Morning Session: 8:30 AM–12:00 noon

V. Workshop on Overfishing Definitions and Biological Reference Points

A. Introduction—Rich Marasco, NMFS

B. NMFS national standards, guidelines, and overfishing definitions—Grant Thompson, NMFS (45 minutes)

C. Comparison of BRPs estimated using a length-based method of the US and Canada snow and Dungeness crab stocks—Shareef Siddeek, ADF&G; Bernard Sainte-Marie, Fisheries and Oceans Canada; Jim Boutillier, Pacific Biological Station; and Gretchen Bishop, ADF&G (45 minutes)

Coffee: 10:00–10:30 AM

D. Biological Reference Points and Harvest Strategies—General discussion

VI. Other business

**SUMMARY OF PRESENTATIONS: INTERAGENCY CRAB RESEARCH MEETING**

December 11–13, 2002 • Hotel Captain Cook, Anchorage

This is a brief bulleted overview of the presentations at the 2002 Interagency Crab Research meeting. The summary reflects the combined notes of Peter van Tamelen and Doug Woodby, and the coverage may be variable from talk to talk. Accuracy of the notes is not guaranteed.

Attendance at the meeting was again high this year with a total of 60 known participants. A list of attendees with contact information is at the end of this document.

## *Part I. Research Review*

### NMFS

RACE Kodiak 2002 Activities—Bob Otto

- Introduced talks by other staff at the lab.
- Bering Sea survey.
- Sampling year around for *C. opilio*.
- Expanding lab work.
- Developing program to assess entire life cycle.
- Historical data mining project with Paul Anderson and Jim Blackburn.
- "Commercially Important Shrimps, Crabs and Lobsters in Alaska" published by PICES.

Crab Disease Research—Frank Morado

- *Carcinonemertes* in *C. bairdi* and surveying species and egg lose rates.
- Investigating Pepper Crab similar to black mat syndrome.
- Cysts in *C. opilio* may be a trematode in genus *Steganoderma*.
- Histological changes in X and Y organs in Tanner crabs.
- New, intensive molecular work beginning on *Hematodinium* in *Chionoecetes* by Pam Jensen.
    - Develop a new diagnostic tool
    - Life history research
    - Genetic comparison of related forms

Chiniak Bay Crab Work—Brad Stevens

- Lab Projects.
- RKC hatching studies: >95% hatching at dusk; female heart rate peaks at hatching.
- RKC Settling study with habitat and predators: glaucothoe get eaten if they don't have refuge habitat.

- Artificial feed development for RKC.
- *C. bairdi* hatching studies.
- ROV and towed sleds with video camera: BRAD-5; Phantom HD2 with side scan sonar is able to detect individual king crabs and Tanner aggregations.

Survival and Growth of Red King Crab Juveniles Reared at Different Temperatures—Kathy Swiney

- 4 temperatures–higher survival at 10°C than at lower temperatures, but longer survival at 6°C.
- Cannibalism was a factor (T. Shirley suggested using salmon rearing trays with individual compartments and lids).

The Use of Live Microalgae in the Culture of Laboratory-Raised Tanner and Snow Crab Larvae—Sara Persselin

- Using *Chroomonas salina* and *Isochrysis galbana* in combination with *Artemia* and local species and tested various combinations.

Research Needs for Crab Stock Assessment Modeling—Jack Turnock

- Inputs to model reviewed.
- Relationship of model and other factors to harvest strategy.
- Survey data doesn't deal with few large catches well and for some stocks precision is low.
- Need other methods to estimate abundance for some stocks (e.g., adaptive sampling, pot survey, tagging, change in ratio, index removal).
- Survey selectivity and catchability.
- Natural mortality difficult to estimate without ability to age crabs.
- Growth increment often use estimates from other stocks or different times.
- Molting probabilities not really known and could use information on shell condition.
- Bycatch mortality not really known and ranging from 20%–100%.
- Mature male biomass: need to know relationship between mature males and egg production.
- Recommends regular review of each stock assessment to identify research needs, critical assumptions, and consistency in models and harvests strategies.

Reproductive Dynamics and Life-History of Bering Sea Snow Crab—Lou Rugolo and Kirsten Gravel

- Introduction: Lou Rugolo, brief overview.
- Goals: elucidate annual female reproductive cycle and dynamics; to detect annual vs. biennial reproduction; molt timing and terminal molt in males.
- Kirsten Gravel: trawl methodologies (sampling every other month) and initial results. Large project with lots of smaller projects going on; includes colorimetry of egg clutch and study of embryogenesis.

**USGS**

Crab Distribution in Glacier Bay—Jim Taggart

- CANCELLED

Recruitment of Dungeness Crabs in an Alaskan Marine Reserve—Ginny Eckert

- How do marine reserves affect the next generation?
- Are populations sources or sinks—where to the larvae go?
- Collect larvae in Bartlett Cove using light traps?
- Variation between years.
- Seems to be related to moon phase.
- Few early stage larvae, suggesting that larvae are not retained in the bay. Habitat for larval settlement is probably limited in the Glacier Bay, a sedimentary system with limited algae and rocky habitat.
- Put out light traps on crab survey throughout bay and arms.

**Universities**

Introduction and Update on Gulf of Alaska Seamount Crabs and Snow Crab Energetics—Tom Shirley

- Seamount explorations looking at crab distributions, habitats, some other things.
- Used Alvin to dive on several seamounts in Gulf of Alaska in string from Cobb hotspot NW towards Kodiak.
- 10 spp. of crab collected.
- Distribution may be set by oxygen minimum zones at upper limits and perhaps biological interactions at lower limit.

Temperature Effects on Reproductive Hormones in *Chionoecetes opilio*—Jaqueline Mitchell

- Characterize reproductive hormones in *C. opilio* females.
- Females kept at 6 different temperatures.
- Potential to use hormonal assays (methyl farnesoate) to determine annual and biennial cycles.

The Effect of Temperature on Embyronic Development and Larval Characteristics in *Chionoecetes opilio*—Joel Webb

- Lab study of embryo and larvae development as a function of temperature.
    - Females reproduce biennially at T of –1°C, annual at T of 3°C–5°C in NW Atlantic.
- Assess larvae characteristics such as morphology and energy content.
- Hatching delayed about 27–28 per °C drop in temperature from 1°C to 0°C to –1°C; implies that would not get a two year cycle even at the lowest temperature of –1°C.

Lipofuscin Aging of Snow Crab–Bodil Bluhm

- Goal is to determine crab age using lipofuscin and then see how lipofuscin age compares to shell size age (lipofuscin is from worn out cell organelles that are oxidatively modified in lysosomes; they accumulate in snow crab brains and autoflouresce).
- Seems to be relationship between lipofuscin and shell size but with some variation, indicating multiple age classes in a size class.
- Expect more detailed results next year.

Hormones and Molting in *Chionoecetes opilio*—Sherry Tamone

- Big question is do they have a terminal molt?
- Since molting is regulated by hormones, it can be determined if a crab is capable of molting.
- By removing eyestalks (eyestalk ablation; eyestalks have sinus gland that releases a molt-inhibiting hormone) a crab can be induced to molt.
- For mature males and females no spike of ecdysteroids is observed after eyestalk ablation, suggesting that they are not capable of molting after the molt to maturity. Current results are based on a small sample size; these results are convincing, but wait until next year for the definitive statement.
- Also never see any premolt setae in mature females and mature males.

Female Ontogenetic Migration in Relation to Near-Bottom Temperature Gradients—Billy Ernst (UW)

- Part of larger project looking at post-terminal molt survival.
- Spatial scales may be important.
- Migration has both seasonal and ontogenetic scales.
- Migrations may be related to temperature.
- Project seeks to describe bottom environments and relate to potential migration characteristics, using NMFS trawl survey data.
- Can observe typical migration patterns in snow crab cohorts.
- The temperature gradients, not necessarily the actual temperatures, are consistent over years.

Tagging Tanner Crabs using Conventional and Sonic Tags to Understand Movement Patterns—Julie Nielsen

- Develop trans molt tag for Tanner crab and potentially snow crabs and test in Glacier Bay.
- Later investigate juvenile habitat for Tanner crab in Glacier Bay.
- Lab study of retention and mortality for both Tanner and snow crab.
- Observed juvenile crabs up bay (Wachusett Inlet) and adults in main Bay area (East Arm entrance).
- Use tags to see if crabs are moving between these areas as they grow.
- Use sonic tags as well to determine movement patterns.

Climatic Changes and Interannual Variation of Dungeness Crab Larvae in Southeastern Alaska—Won Park

- Collect larvae from Chatham Strait through Icy Strait to open ocean as well as measuring physical properties (4 sets of stations).
- Variation between years with older larvae in open ocean.
- Sea surface temperature was correlated with larval age.

Movement and Habitat Utilization of Golden King Crabs in Southeast Alaska—Zac Hoyt

- Given by Tom Shirley.
- Tagged crabs with sonic tags in Frederick Sound (southeast Alaska).
- Feeding energetics of snow crabs.
- Does female energetics vary with age and temperature?
- Old shell crabs die at higher rates than new shell crabs.

**ADF&G**

King and Tanner Crab Research Overview—Jie Zheng

- Handout giving details of talk.
- Reviewed current and future research data including population estimation, stock productivity, harvest strategies, and other studies (gear and bycatch).

Southeast King and Tanner Stock Assessment—John Clark

- Changed topic: developing a Tanner crab management plan.
- Overview of fishery, summary of BOF directive, current stock status for surveys and industry.

Southeast Dungeness Stock Assessment and Management—Jan Rumble

- Research on Dungeness crab using surveys and tagging. Fishery has intensified: limited entry, increased reliance for income, fishing whole season, and recruit driven fishery. Have tagged ~ 7,000 crabs, over 1,000 returns.
- Survey to determine basic life history characteristics, index of abundance.

History and Recent Management Activity of the Petrel Bank Red King Crab—Karla Granath

- Survey design run by industry in winter and fall.
- Survey indicated a fishery could be conducted.
- Fishery conducted and lasted 50 hours and took 505,000 pounds.

New Management Strategies in Chignik, Kodiak, and the South Peninsula—Mike Ruccio

- Harvest strategies for Tanner crab in Kodiak region.
- Trawl survey to estimate abundance directly.

Bering Sea and Aleutian Island Pot Survey Update—Leslie Watson

- Golden king crab pot survey in Aleutian Islands.
- Tagged average of 11,000 crabs per survey in recent triennial surveys.

- Survey report available very soon.
- One female at large for 11 years.
- Growth increment is very small.
- Blue king crabs in St. Matthew Island: distribution and seasonal movements.
- Documentation of infestation of snailfish eggs in blue king crab.

Bristol Bay Red King Crab Injury and Tagging Update—Skip Gish

- What is mortality due to bycatch?
- Used tagging of injured and uninjured crabs and compared recovery rates.
- Injuries were rostrum break and leg crush.
- Return rate of injured crab was about 75% that of the controls after 2 weeks at large; overall results are not clear.

Size at Maturity in Crabs—Dan Urban

- Used computer imaging to determine size at maturity in Tanner crab, measuring to 0.2 mm. This provides a cleaner break between mature and immature as compared to hand caliper method.
- Looked at size at maturity and found difference in size between nearby bays.
- To examine shell shape over the life span of a crab, used computer imaging to measure from center of carapace to edge in one degree increments.
- Looks like there are groupings for each instar.

King Crab Manual Update—Susie Byersdorfer

- King crab manual will be coming out in the next few years; Bill Donaldson is under contract to put this together.
- It will be very similar to the *Chionoecetes* manual.
- She is looking for input on the manual.

Central Region—Bill Bechtol

- Fishery description: commercial fishery closed since 1994 and sport use mostly near Homer.
- Discussed harvest strategies, regulations, harvest statistics, problems.

Personal Use Tanner Crab in Cook Inlet—Nicky Szarzi

- Combined with Bill Bechtol.

Nome Triennial Survey—Betsy Brennan

- 2002 trawl survey. Trawl methods discussed. 60 tows of 76 attempts.

Update of Molecular Genetics of Study of Red King Crab—Stew Grant

- Project goals: identify stocks, historical demographies.
- 3 major groups of red king crab: Southeast Alaska peninsula, Aleutians and Bering Sea, and Norton Sound and Russia.
- Tanner-snow crab hybrids.

- Background estimate of hybrids has been about 2%–5% using both genetics and morphology.
- Using morphology found 20% hybrids in 2002.
- Developing methods to estimate past demographies based upon mitochondrial DNA.

Revised Research Plan—Doug Woodby
- Suggests revising long-term crab research plan.
- Reviewed 1995 plan proposed by Gordon Kruse in High Latitude Crabs.
- Needed first is a summary of what was accomplished from the 95 plan.

Next Year's Meeting and Special Topic Suggestions
- Timing is good. Tentative dates for 2003: December 10-12.
- Topics (suggested after the meeting):
    - Larval life histories
    - Physical and Biological linkages (per PISCO of west coast states)

## *Part II: Overfishing and Biological Reference Point*

Introduction: Rich Marasco

NMFS National Standards, Guidelines, and Overfishing Definitions—Grant Thompson
- CANCELLED

Comparison of BRPs Estimated Using a Length-Based Method of the US and Canada Snow and Dungeness Crab Stocks—Shareef Siddeek
- What are Biological Reference Points?
- Indicators of stock health in terms of F, B, and important reproductive features.
- A length-based method to determine BRPs, which is applicable to data poor and data rich stocks.
- Harvest rate- and biomass-based BRP values are depended on the choice of stock-recruitment model, natural mortality, mating ratio, initial sex composition, etc.
- Many life history parameters are unknown even for data rich stocks.
- Under these circumstances, precautionary BRP values within feasible range of life history parameter values are suggested.

General Discussion—Biological Reference Points and Harvest Strategies

Discussion question "What is our management goal?" Various answers:
- Total mortality, not just fishing mortality.
- Maintaining reproductive potential, as in total fertilized egg production.
- Lack of full fertilization is a "red light" situation.
- Reproductive potential is affected by egg predators, disease, and possibly the number of males.

- Caveat: population control may be strongest in first 2 years of life, dependent on predation, available habitat, and environmental conditions.
- These issues should be part of long-term research plan.

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